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ARIZONA
Agricultural Experiment
STATION.

BULLETIN NO. 19.

Sixth Annual Report.

WM. STOWE DEVOL, Director.

Tucson, Arizona, January, 1896.

Arizona Agricultural Experiment Station,

GOVERNING BOARD (REGENTS OF THE UNIVERSITY):

Appointed by the Governor of the Territory—

HOWARD BILLMAN, A. M., Chancellor ..	Tucson
J. G. HILZINGER, A. M., Secretary.....	Tucson
SELIM M. FRANKLIN, Ph. B., Treasurer.....	Tucson
E. R. MONK, A. M.....	Tucson

Ex-Officio—

HON. LOUIS C. HUGHES.....	Governor of the Territory
HON. F. J. NETHERTON.....	Superintendent of Public Instruction

STATION STAFF.

HOWARD BILLMAN, A. M.....	President
WM. STOWE DEVOL, B. Agr., Director	Agriculturist and Horticulturist
EDWARD M. BOGGS	Irrigation Engineer and Meteorologist
JAMES W. TOUMEY, B. S.....	Botanist and Entomologist
ROBERT H. FORBES, B. S.....	Chemist

MARK WALKER.....	Assistant Horticulturist	} Station No. 1. Tucson.
R. J. FERGUSON.....	Machinist	
MARK WALKER, JR.,	Ass't in Chemical Laboratory	
G. M. GILLETT.....	Ass't Meteorologist	
LEE LACHANCE	Stenographer	

N. H. CLAFLIN, M. D., Foreman.....	Station No. 2, Phoenix
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The Bulletins of the Station are sent gratis to all residents of Arizona applying for them.

The Experiment Station respectfully solicits suggestions relating to the important work it is attempting to accomplish in the development of the agricultural resources of the Territory.

Questions upon subjects within the scope of the Station work will be cheerfully answered whenever possible.

Address all communications to

DIRECTOR EXPERIMENT STATION,

Tucson, Arizona.

Financial Report

For the Fiscal Year Ending June 30th, 1895.

*Agricultural Experiment Station of the University of Arizona,
in account with*

THE UNITED STATES APPROPRIATION, 1894-5.

Dr.			
To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1895, as per Act of Congress approved March 2, 1887		\$ 15 000	00
Cr.			
Abstract:			
By Salaries	1.....	\$ 6 491	20
Labor.....	2.....	2 917	37
Publications.....	3.....	159	36
Postage and stationery.....	4.....	226	86
Freight and express	5.....	505	20
Heat, light and water.....	6.....	735	98
Chemical supplies.....	7.....	226	08
Seeds, plants and sundry supplies	8.....	543	57
Fertilizers.....	9.....	114	60
Feeding stuffs	10.....	308	37
Library	11.....		
Tools, implements and machinery.....	12.....	608	59
Furniture and fixtures.....	13.....	96	18
Scientific apparatus.....	14.....	485	83
Live Stock	15.....		
Traveling expenses.....	16.....	929	25
Contingent expenses.....	17.....	33	90
Building and repairs.....	18.....	774	37
Balance.....		183	29
Totals.....		\$ 15 000	00

We, the undersigned, duly appointed auditors for the corporation, do hereby certify that we have examined the books and accounts of the Experiment Station of the University of Arizona, for the fiscal year ending June 30th, 1895; that we have found the same well kept and correctly classified as above, and that the receipts for the time named are shown to have been \$15,000 00, and the corresponding disbursements \$14,816 71, for all of which proper vouchers are on file, and have been by us examined and found correct, thus leaving \$183.29.

HOWARD BILLMAN,
EDWARD R. MONK,
SELIM M. FRANKLIN,

Auditing Committee of the Board of Regents.

I hereby certify that the foregoing statement of account, to which this is attached, is a true statement from the books of account of the institution named.

(SEAL)

SELIM M. FRANKLIN,
Treasurer.

We, the undersigned, do hereby certify that the above is the signature of Selim M. Franklin, treasurer of the Agricultural Experiment Station of the University of Arizona, and that the above is the seal of said institution.

J. GEO. HILZINGER,
Secretary Agricultural Experiment Station,
University of Arizona.

WM. STOWE DEVOL,
Director of Experiment Station.

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List of Bulletins

PUBLISHED BY THE ARIZONA AGRICULTURAL EXPERIMENT
STATION TO DECEMBER 31ST, 1895.

Copies will be sent gratis to all applicants so long as the supply lasts.
Nos. 2 and 3 are already exhausted Address

DIRECTOR EXPERIMENT STATION,
Tucson, Arizona.

- 1—Arizona Experiment Station.
- 2—Part I, Notes on Some of the Range Grasses of Arizona.
Part II, Overstocking the Range.
- 3—Irrigation in Arizona.
- 4—Waters and Water Analysis.
- 5—Canaigre.
- 6—Soils and Waters.
- 7—Canaigre.
- 8—Cattle Feeding.
- 9—Insects and Insecticides.
- 10—Experimental Work at Willcox.
- 11—Agricultural Development in Southwestern Arizona.
- 12—Preliminary Report of Observations on the Crown-Knot.
- 13—The Mesquite Tree: Its Products and Uses.
- 14—Notes on Scale Insects in Arizona.
- 15—List of Varieties of Fruits.
- 16—Notes on Apricots at Phoenix Station.
- 17—Agricultural Convention. Part I.
- 18—Agricultural Convention. Part II.

Report of the Director.

Howard Billman, President,

Dear Sir: On January 15th, 1895, I assumed the duties of the office of agriculturist and horticulturist of the Station and have labored in that capacity throughout the year. On June 27th, 1895, the additional duties and responsibilities of the office of director were imposed by the resignation of Dr. Theo. B. Comstock from this office and my election to the place by the Honorable Board of Regents. In September Dr. Comstock resigned the presidency and Howard Billman, A. M., was chosen his successor. In August Mr. Lee LaChance became stenographer and October 1st, Mr. G. M. Gillett became assistant meteorologist, relieving Mr. Mark Walker, Jr., who remained acting assistant in the chemical laboratory. There have been no other changes in the Station staff during the year.

A large collection of fruit and ornamental trees had been purchased in the East before my arrival, and my first duty was to distribute and set these. A few more were placed upon the grounds at Station No. 1, at Tucson, part were planted at Station Number 2 at Phoenix; others were distributed to private individuals in the central and northern parts of the Territory. During the winter and early spring careful measurements were made upon the growth of all the older fruit trees at Phoenix and Tucson and the matter has been prepared in the form of a bulletin. During the summer the growth, flowering and fruiting of the varieties of trees were carefully studied and the notes upon the apricots at Phoenix published as Bulletin No. 16. A large number of forage plants, chiefly of species and varieties of sorghums and of leguminous plants, were tried at Tucson and Mesa, and at the latter place a number of kinds of garden vegetables were grown. A package of roots supposed to be of the new forage plant saccaline (*Polygonum sachalinense*), were received from the Department of Agriculture, Washington, D. C., and some planted at each of the stations and at Yuma. The plants proved to be of another species (*P. cuspidatum*), which is worthless for this region. The most promising of the new forage plants for dry and alkaline

soils is what is known as the "Australian Salt Bush" (*Atriplex semibaccatum*.) Plants of this species upon the grounds at Tucson received but one good irrigation during the season, yet made a strong and thrifty growth.

The soil at the University where the Tucson Station is located having been demonstrated totally unfit for the growth of fruit trees, all that were planted there have been removed.

In addition to the work upon the several Stations and the administrative duties, the director has prepared four bulletins during the year and a part of the year devoted half his time to University work. Under date of July 19th a call, signed by the director, was issued for a convention of farmers, fruit growers and stockmen to be held in Phoenix in the autumn. In response to this about one hundred men assembled at the Opera House on the 17th and 18th of October and an instructive program was carried out, in which all the members of the scientific staff of the Station participated. A permanent organization, to be known as the Arizona Agricultural Association, was formed at this convention and the director of the Station was chosen its president. The director also delivered an address before the Dairyman's Association, near Tempe. The planting of an experimental nature upon the prison farm at Yuma has also been under the superintendence of the director.

During the past year the following bulletins have been published:

13. "The Mesquite Tree: Its Products and Uses," by Robert H. Forbes, chemist.

14. "Notes on Scale Insects," by James W. Toumey, botanist and entomologist.

15. "Lists of Varieties of Fruits," by Wm. Stowe Devol, *director*, agriculturist and horticulturist.

16. "Notes on Apricots," by Wm. Stowe Devol, *director*, agriculturist and horticulturist.

17. "Agricultural Convention," Part 1, edited by Wm. Stowe Devol, *director*, agriculturist and horticulturist.

18. "Agricultural Convention," Part 2, edited by Wm. Stowe Devol, *director*, agriculturist and horticulturist.

The following articles have been donated to the Station and acknowledgement is hereby made:

1 Package "Lactic Ferment," from Chr. Hansen's laboratory, Little Falls, N. Y.; 1 package of sample bags and sacks from Neville & Co., 31-33 California St., San Francisco, Cal.; 1 "B" and 1 steel hind pattern "Never-slip" horseshoe, from Neverslip Horseshoe Co., 31 India Wharf, Boston, Mass.; 1 package "Phenyle Disinfectant" from Bannerman & Co., 113 E. Adams St., Chicago, Ill.; 1 graft "Giant Wickson" plum, from Burbank's Experiment Farm, Santa Rosa, Cal.; 1 package Casabanara seed, from J. L. Normand, Marksville, La.; 100 "Stay There" Ear Markers and 1 tool for applying same, from W. W. Wilcox & Co., 195-197 Lake St., Chicago, Ill.; 1 package each of "Dr. Rowe's Stock Food" and "Dr. Rowe's Poultry Food," from Hawkeye Stock Food Co., Marion, Iowa.; 1 package "Horse and Cattle Food," from F. E. Sanborn Company, Omaha, Neb.; Samples "Cabot's Insulating and Sheathing Quilt," from Samuel Cabot, 70 Kilby St., Boston, Mass.; 1 large package Ramie seed, from H. L. Chandler, Phoenix, Ariz.; 2 papers vegetable seeds from Delano Moore, Presque Isle, Me.; Collection vegetable and flower seeds, from W. Atlee Burpee & Co., Philadelphia, Penn.; collection vegetable and flower seeds, from Henry A. Dreer & Co., Philadelphia, Pa.; 2 packages seeds, *Atriplex semibaccatum*, and 1 package seeds, *Medicago turbinata*, from California Experiment Station, Berkeley, Cal.; 1 package seeds, *Hibiscus subdoriffa*, and 1 package seeds, *Atriplex semibaccatum*, from Southern California Station, Pomona, Cal.; Specimens "Cabot's Creosote Shingle Stains," from Samuel Cabot, 70 Kilby St., Boston, Mass.; Samples "Asphalt Roofing Felt," from McTear & Co., Lmt., 117-121 Corporation St., Belfast, Ireland; 1 pail (25 pounds) "Dr. Rowe's Stock Food," from Hawkeye Stock Food Co., Marion, Iowa; 1 flower pot, from J. G. Swahn's Sons, Minneapolis, Minn.; 100 "Aluminum Stock Tags," 1 tool for applying same, 1 pair pig forceps, from Chas. Barber, Tiskilwa, Ill.; 1 Carmen gooseberry, 1 Gault raspberry, from The Storrs & Harrison Co., Painesville, Ohio.

Through the courtesy of the publishers the following periodicals are placed upon the Station library table in exchange for the bulletins of this Station. With the exception of five or six, all have been added during the past five months, upon request of the director.

Agricultural Gazette, Sidney, N. S. W.; *American Agriculturist*, New York, N. Y.; *American Horticulturist*, Wichita, Kansas; *Baltimore Weekly Sun*, Baltimore, Md.; *California Cultivator*, Los Angeles, Cal.; *Elgin Dairy Report*, Elgin, Ill.; *Farm and Orchard*, Las Cruces, N. M.; *Farm News*, Springfield, Ohio; *Farmers' Home*, Dayton, Ohio; *Farmers' Magazine*, Springfield, Illinois; *Grange Visitor*, Charlotte, Michigan; *Hoard's Dairyman*, Fort Atkinson, Wis.; *Horticultural Gleaner*, Austin, Texas; *Industrial American*, Lexington, Ky.; *Leather Manufacturer*, New York, N. Y.; *Market Garden*, Minneapolis, Minn.; *National Stockman*, Pittsburg, Penn.; *Northwestern Weather and Crops*, Minneapolis, Minn.; *Oregon Agriculturist*, Portland, Ore.; *Pacific Coast Dairyman*, Tacoma, Wash.; *Progressive South*, Richmond, Va.; *Southern States*, Balti-

more, Md.; *Southwestern Stockman, Farmer and Feeder*, Phoenix, Ariz., *Success with the Garden*, Rose Hill, New York, N. Y.; *Successful Farm*, Sioux Falls, S. D.; *Sugar Beet*, Philadelphia, Pa.; *Reliable Poultry Journal*, Quincy, Ill.; *Southern Cultivator*, Atlanta, Ga.; *Rural World*, London, W. C. Eng.; *The Homestead*, Des Moines, Ia.; *Texas Farm and Ranch*, Dallas, Texas.; *The Western Soil Culture*, Sioux City, Ia.; *Wallace's Farmer and Dairyman*, Des Moines, Ia.; *Wisconsin Agriculturist*, Racine, Wis.

The work of the respective departments has gone forward uninterruptedly and has been prosecuted with zeal in all of them. The reports of the members of the Station staff for their several branches have been filed with the director and an outline of the work of each is given below.

Respectfully submitted,

WM. STOWE DEVOL,

Director.

The heads of departments filed with the director reports covering the work accomplished during the year. As the director, irrigation engineer, botanist and entomologist and chemist are employed in the dual capacities of workers in the Experiment Station and instructors in the University, a considerable portion of their time has been given to the latter. In addition to the work mentioned by the director in his report, a very considerable portion of his time has been taken in putting into permanent form for preservation records of all the experiment work in agriculture and horticulture heretofore done at the Station. The correspondence of the Station has been large, upwards of 1100 letters having been written by the director within the past six months.

The irrigation engineer and meteorologist has prepared an elaborate bulletin upon the climate of Arizona and done some work upon a second bulletin, upon the division and measurement of water. He has made a number of trips to various points in the Territory to examine and report upon the water supply and feasibility of storing water; also for the purpose of gaging the flow of water in streams.

The botanist and entomologist has prepared a bulletin on "Scale Insects," and in his research in the field and laboratory has discovered several species of insects new to science, and several new plants. He has made a further study of the crown root knot, of the native cacti, of weedy plants, of the scale insects and of insects injurious to the canaigre and other plants.

The chemist prepared a bulletin on "The Mesquite Tree," and has given most of his time to the chemical investigations of the canaigre plant in all its relations. Some soils and waters have been examined, and a large number of soil samples taken, representing practically all the soils of the Salt River Valley.

Each of the above-mentioned members of the Station staff prepared two papers for the farmers' convention held at Phoenix in October, and the director and chemist presented papers at a meeting of dairymen at Tempe.

The assistant horticulturist has had charge of the labor upon the grounds at the University and superintended all the planting done there. He conducted the greenhouse work and propagated about 4,000 plants for use upon the grounds and for distribution.

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SEVENTH ANN. REP.

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Arizona
Agricultural * Experiment
Station.

BULLETIN NO. 24.

Seventh Annual Report.

BY
WM. STOWE DEVOL,
DIRECTOR.

Tucson, Arizona, January, 1897.

FINANCIAL REPORT

*For the Fiscal Year Ending June 30th, 1896. Agricultural Experiment
Station of the University of Arizona, in account with*

THE UNITED STATES APPROPRIATION, 1895-6.

DR.			
To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1896, as per Act of Congress approved March 2, 1887.....		\$ 15 000	00
CR.			
		Abstract:	
By Salaries.....	1.....	6273	17
Labor.....	2.....	3676	17
Publications.....	3.....	334	80
Postage and stationery.....	4.....	326	78
Freight and express.....	5.....	266	70
Heat, light and water.....	6.....	300	00
Chemical supplies.....	7.....	484	84
Seeds, plants and sundry supplies.....	8.....	156	23
Fertilizers.....	9.....	466	38
Feeding stuffs.....	10.....	274	66
Library.....	11.....	380	00
Tools, implements and machinery.....	12.....	358	99
Furniture and fixtures.....	13.....	63	85
Scientific apparatus.....	14.....	205	34
Live Stock.....	15.....		
Traveling expenses.....	16.....	860	75
Contingent expenses.....	17.....	205	18
Building and repairs.....	18.....	729	42
Balance.....		12	91
Totals.....		\$ 15 000	00

We, the undersigned, duly appointed auditors of the corporation, do hereby certify that we have examined the books and accounts of the Agricultural Experiment Station. University of Arizona, for the fiscal year ending June 30th, 1896; that we have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been \$15,000 00, and the corresponding disbursements, \$14,987 09; for all of which proper vouchers are on file, and have been by us examined and found correct, thus leaving \$12 91 unexpended.

HOWARD BILLMAN,
EDWARD R. MONK,
SELIM M. FRANKLIN,
Auditing Committee of the Board of Regents.

I hereby certify that the foregoing statement of account, to which this is attached, is a true statement from the books of account of the institution named.

[SEAL]

SELIM M. FRANKLIN,
Treasurer.

We, the undersigned, do hereby certify that the above is the signature of Selim M. Franklin, treasurer of the Agricultural Experiment Station of the University of Arizona, and that the above is the seal of said institution.

J. GEO. HILZINGER,
Secretary Agricultural Experiment Station,
University of Arizona.

WM. STOWE DEVOL,
Director of Experiment Station.

LIST OF BULLETINS

PUBLISHED BY THE ARIZONA AGRICULTURAL EXPERIMENT
STATION TO DECEMBER 31st, 1896.

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Those designated by an asterisk (*) are already exhausted. Address

DIRECTOR EXPERIMENT STATION,
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- 16—Notes on Apricots at Phoenix Station.
- 17—Agricultural Convention. Part I.
- 18—Agricultural Convention. Part II.
- 19—Sixth Annual Report.
- * 20—Arizona Weather.
- 21—Canaigre.
- 22—Something about Weeds.

REPORT OF THE DIRECTOR.

HOWARD BILLMAN, *President*.

DEAR SIR:—I beg leave to submit the following brief report of the work of the Experiment Station for the year ending December 31, 1896.

The work accomplished during the year was on the whole more satisfactory than that of the preceding year because of there having been fewer changes in the station staff and the members of the staff being in consequence more familiar with the duties of their respective departments. The only change made during the year was that of abolishing the office of assistant horticulturist in July, which had been filled

for upwards of five years by Mr. Mark Walker. This necessitated the employment of a foreman upon the grounds at Tucson, and Mr. H. G. Wolfgang came to fill that position in August. The work in all the departments has progressed harmoniously.

It having been demonstrated that the forty acre tract on which the university buildings are located is unfit for the cultivation of fruits, vegetables and general farm crops it became necessary to secure additional land in the vicinity of Tucson for the purpose of making further studies in the cultivation of canaigre, instituting experiments with sugar beets and making further experiments with tobacco. For this purpose a tract of ten acres was obtained with an option upon additional ground if found necessary. The land thus secured is a moderately rich, but very sandy loam, in the Santa Cruz valley and lying just west of the corporation line of the city of Tucson. The plan was to institute a systematic group of experiments with canaigre to ascertain primarily the cost of production under different methods of culture, etc., but it being found impossible to obtain a sufficient quantity of roots of cultivated canaigre it was necessary to abandon in part the experiment for the past season and devote as much of the ground as thought necessary to the growing of seed roots for instituting this work during the coming year. For this purpose about six acres of ground was planted to canaigre, part of it being included in the regular series of experiments as outlined in the beginning.

Acting upon the advice of Director True, of the Office of Experiment Stations, United States Department of Agriculture, Washington, D. C., substations three and four, at Mesa and Willcox respectively, were abandoned, Director True having expressed the opinion that the law did not contemplate more than one experiment station. Because of the large expenditure in bringing the station at Phoenix to its present condition, the comparatively large number of fruit trees growing thereon and comparatively small expense at which it may be continued, permission was granted to keep the station in operation at that place.

The work at the Phoenix station has been mainly with fruits, the object being to determine varieties best suited to conditions prevailing in Arizona. Among the grapes a large number of varieties were found to give very satisfactory results last season, some of which are varieties grown in the eastern states. A few of these eastern grapes have proved very prolific and the quality was very satisfactory last season. The canaigre work has been continued upon the Phoenix station, an important feature of which was growing canaigre from sprouts taken from roots which had started to grow before they were planted. Fine roots of large size and apparently excellent quality were obtained from these sprouts, but it remains to be seen whether sprouts of sufficient number can be obtained by any method to warrant the propagation of canaigre by this means.

Experiments with varieties of tobacco were begun upon the Phoenix

station, about thirty varieties being used. The plants were propagated at Tucson and shipped to Phoenix. This method was found very unsatisfactory, however, as the plants were injured in shipping and many failed to grow when transplanted. Some varieties of excellent quality were produced however and are now in the process of curing.

Experiments with ramie were continued and a very satisfactory growth was obtained at the Tucson station as well as at Phoenix. Observations were continued through the year upon the habit, growth and probable value of Australian salt bush. I am of the opinion that this will prove a very valuable forage plant in many parts of Arizona as it has withstood droughts exceedingly well.

The date trees upon the grounds at Phoenix have been objects of much interest, not only to residents of Arizona but to people in many parts of the United States, and continued observations upon the growth of this fruit points to the fact that dates of excellent quality can be produced in Arizona and suggests that the date may yet prove a very valuable crop in this Territory.

Among ornamental trees the peppers have given most excellent satisfaction for lawn purposes at the University. The native walnut has also done comparatively well. Umbrellas prove satisfactory though subject to mutilation by heavy winds. The mulberry has proved one of the most thrifty of shade trees, while the native ash still stands near the head of the list of valuable shade trees for Arizona. Observations with other ashes show that some of them are well adapted to the conditions prevailing in Arizona. The European sycamore has been found worthless for this region.

Experiments were begun with grasses of the arid regions and seeds of the following varieties sown, about one square rod of each:

Atriplex semibaccatum (Australian Salt Bush), *Medicago turbinata* (Snail Clover), *Desmodium tortuosum*, *Sioy.* (Florida beggar weed), *Lespedeza striata* (Japan Clover), *Panicum sanguinale* (Red crowfoot), *Andropogon furcatus* (Big blue stem), *Iris pabularia*, *Ammophila arundinacea* (Beach grass), *Trifolium Alexandrium* (Egyptian clover), *Andropogon nutans* (Bushy blue stem), *Agrostis vulgaris* (Bent grass-Red top), *Eragrostis Neo Mexicana*, Vasey, *Eragrostis abyssinica* (Teff). *Poa Nevadensis* (Nevada blue grass), *Pappophorum laguroideum* (Mexico or bunch grass), *Panicum Texanum* (Texas millet or Colorado grass), *Panicum miliaceum* (Indian or common millet), *Agrophyrum repens* (Quack grass), *Pappophorum laguroides* (Beard grsss), *Medicago maculata* (Burr clover), *Bouteloua oligostachya* (Gramma grass), *Festuca duriuscuta* (Hard fescue grass), *Cynosurus cristatus* (Crested dogstail), *Cynoden dactylon* (Bermuda grass), *Eleusine coracana* (Indian crowfoot), *Muhlenbergia glomerata* (Clover-head grass), *Bouteloua curtipendula*, Neb., *Desuiceliya molle*, *Koaleria nitida*, *Bromus unioloides* (Rescue grass), *Poa Montana* (Montana blue grass), *Muhlenbergia*

sylvatica, *Diplachne imbricata* (Spike grass), *Eleusine barcinocuse*, *Alopecurus alpestris*, *Atriplex halimoides* (Australian Salt bush).

Many of the seeds failed to grow, the ground upon which they were sown having considerable adobe, and it consequently baked pretty hard after being flooded. The following, however, made a very satisfactory growth: Australian Salt Bush, Snail Clover, Florida Beggar Weer, Bushy Blue-Stem, Mexico or Bunch Grass, Colorado Grass, Common Millet, Indian Crowfoot.

An experiment in feeding dairy cows was conducted at Tempe through the greater part of the year but owing to the cattle not being placed completely in the control of the station the work was very unsatisfactory.

The preparation of the greenhouse for the reception of plants was completed and the work of stocking the greenhouse progressed as rapidly as possible under the circumstances, there being no funds available for the purchase of plants and the stock, therefore being provided by donations and through the medium of propagation of such plants as we had. Experiments have been instituted in growing several varieties of vegetables under glass, chief among which were lettuce and tomatoes. Notable success has been achieved in the culture of lettuce, the quality of that grown in the greenhouse being superior. A portion of the greenhouse has been devoted to canaigre work.

The meteorological department has continue the collection of weather data throughout the year and one bulletin has been published from this department.

The principal work of the department of botany and entomology has been the study of the weeds of Arizona, injurious insects, and an exhaustive study of crown root knot with experiments in methods of eradicating it. Some observations have also been made in connection with other departments as to the prevalence of root rot in the Territory and causes leading thereto. One bulletin has been prepared by this department upon "Something About Weeds."

The chemical department has continue the investigation of canaigre, publishing a bulletin upon this subject. Some time was devoted also to the analyses of soils and waters of Arizona and the analysis of milk in connection with the cattle feeding experiment.

Two farmers' institutes were held during the year chiefly under the auspices of the officers of the Experiment Station, both at Phoenix, one held in January and the other in November. At both of these meetings the director delivered an address. He also gave two addresses upon the University, one at Holbrook and one at Snowflake.

The following bulletins were prepared for publication during the year:

19—Sixth Annual Report, by Wm. Stowe Devol, *Director*, *Agriculturist* and *Horticulturist*.

20—Arizona Weather, by Edward M. Boggs, Irrigation Engineer and Meteorologist.

21—Canaigre, by Robert H. Forbes, Chemist.

22—Somthig About Weeds, by James W. Toumey, Botanist and Entomologist.

The thanks of the Station are hereby extended to the following persons for the donations made to the station, as indicated: J. L. Normand, Marksville, Louisiana, Cassabanana seed; W. W. Wilcox & Co., Chicago, Illi. "Stay there" stock tages and tool for applying same; A. W. Livingston's Sons, Columbus, Ohio, collection of seeds and two new varieties of potatoes; Lee LaChance, Tucson, Eucalyptus trees; Mrs. M. C. Kimball, National City, Cal., seeds and specimens of leaves and pods of eucalyptus trees; W. Atlee Burpee & Co., Philadelphia, Pa., several collections of seeds; University of California, 29 papers of seeds; J. C. Suffern, Voorhies, Ill., seeds; Bannerman & Co., Chicago, Ill., "Phenyle Disinfectant"; U. S. Department of Agriculture, grass seeds; Richard Nott, pea seeds; Division of Botany, U. S. Dept. Agriculture, 2 papers *Atriplex halamoides*; Northwestern Seed Co., Dundas, Minn., vegetable and flower seeds; E. de Gonceli, Corallitos, Mexico, samples of canaigre tanned leather; A. V. Whiteman, New York, N. Y., 2 quart milk bottles; C. H. Dietz, New York, N. Y., sugar beet seed; Louis F. Fischer, Mazatlan, Mexico, several specimens, Indian and East African seeds, W. W. Lord, Los Angeles, Cal., *Atriplex numularia* and *Atriplex halamoides* seed; Dr. Alexander Trippell, Mesa, Arizona, sample almonds, Ne Plus Ultra; J. C. Vaughan, Chicago, Ill., garden seeds for forcing; A. H. Vail, Mammoth, Arizona, 2 apple trees; Waterbury Rubber Co., 1 "Comet" lawn sprinkler and 18 feet "Sphincter" grip steel armoured hose.

The following periodicals are received in exchange for our station bulletins and placed in the reading room of the experiment station:

"American Agriculturist", Mid. Edition, weekly, New York.

"Agricultural Gazette," monthly, Sidney, N. S. W.,

"American Fertilizer," monthly, Philadelphia, Pa.

"Baltimore Weekly Sun", weekly, Baltimore, Md.

"San Francisco Call", weekly, San Francisco, Cal.

"Corn Belt", monthly, Chicago, Ill.

"California Advocate", monthly, San Francisco, Cal.

"Colman's Rural World", weekly, St. Louis, Mo.

"Citizen", daily, Tucson, Arizona.

"Examiner", weekly, San Francisco, Cal.

"Express", weekly, Los Angeles, Cal.

"Elgin Dairy Report", weekly, Elgin, Ill.

"Farmers Voice", weekly, Chicago, Ill.

"Farmers Advocate", monthly, London, Ontario, Can.

"Farm Magazine", monthly, Kloxville, Tenn.

"Farmers' Magazine", monthly, Springfield, Ill.

"Farm and Home", semi-monthly, Chicago, Ill.

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- "Farmers' Home", weekly, Dayton, Ohio.
 "Farm News", monthly, Springfield, Ohio.
 "Farmers' Guide", semi-monthly, Huntington, Ind.
 "Grange Visitor", weekly, Charlotte, Mich.
 "Hoard's Dairyman", weekly, Fort Atkinson, Wis.
 "Herald", daily, Los Angeles, Cal.
 "Horticulture", monthly, Cuyahoga Falls, Ohio.
 "Horticultural Gleaner", monthly Austin, Texas.
 "Homestead", weekly, Des Moines, Iowa.
 "Irrigation Age", monthly, Chicago, Ill.
 "Indiana Farmer", weekly, Indianapolis, Ind.
 "Industrial American", semi-monthly, Lexington, Ky.
 "Leather Manufacturer", monthly, New York, N. Y.
 "Los Angeles Times", weekly, Los Angeles, Cal.
 "Market Gardening", monthly, Minneapolis, Minn.
 "Nevada State Journal", weekly, Reno, Nev.
 "New Era", weekly, Perris, Cal.
 "National Stockman", weekly, Pittsburg, Pa.
 "New York Weekly Witness", weekly, New York, N. Y.
 "New England Florist", weekly, Boston, Mass.
 "Oregon Agriculturist", monthly, Portland, Oregon.
 "Pomona Progress", weekly, Pomona, Cal.
 "Public Ledger", daily, Philadelphia, Pa.
 "Progressive South", monthly, Richmond, Va.
 "Pacific Tree and Vine", monthly, San Jose, Cal.
 "Pacific Coast Dairyman", weekly, Tacoma, Wash.
 "Rural World", weekly, London, England.
 "Southern States", monthly, Baltimore, Md.
 "Success with the Garden", monthly, Rose Hill, N. Y.
 "Southern Planter", monthly, Richmond, Va.
 "Southern Farmer", weekly, New Orleans, La.
 "Southern Cultivator", semi-monthly, Atlanta, Ga.
 "Southwestern Stockman", weekly, Phoenix, Ariz.
 "Star", daily, Tucson, Ariz.
 "Texas Farmer", weekly, Dallas, Texas.
 "Texas Farm and Ranch", weekly, Dallas, Texas.
 "Texas Stock and Farm Journal", weekly, Fort Worth, Texas.
 "Weekly Market Letter", weekly, New York, N. Y.
 "Western Creamery", monthly, San Francisco, Cal.
 "Wallace's Farmer", weekly, Des Moines, Ia.
 "Wisconsin Agriculturist", semi-monthly, Racine, Wis.
 "Western Agriculturist and Livestock Journal", semi-monthly, Quincy, Ill.
 "Weekly Times-Index", weekly, San Bernardino, Cal.
 "West Virginia Farm Reporter", monthly, Charleston, W. V.

The following publications have been placed upon the reading table by the Director:

"American Agriculturist", Western Ed., weekly, San Francisco, Cal.

"American Gardening", weekly, New York, N. Y.

"Breeders Gazette", weekly, Chicago, Ill.

"Jersey Bulletin", weekly, Indianapolis, Ind.

"L. A. W. Bulletin and Good Roads", weekly, New York, N. Y.

"Rural Californian", monthly, Los Angeles, Cal.

In order to secure more hearty cooperation and thus facilitate work in the respective departments monthly meetings of the station staff have been held in the office of the director throughout the greater part of the year. At these meetings the work has been discussed and mapped out more or less completely and an effort made to follow out the lines laid down at such meetings. In addition to this the heads of the respective departments have submitted monthly reports of the work done each month.

WM. STOWE DEVOL,
Director.

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Arizona
Agricultural * Experiment
Station.

BULLETIN NO. 25.

Eighth Annual Report.

BY
WM. STOWE DEVOL,
DIRECTOR.

Tucson, Arizona, June, 1897.

Arizona Agricultural Experiment Station.

Appointed by the Governor of the Territory.

GOVERNING BOARD (REGENTS OF THE UNIVERSITY).

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STATION STAFF.

HOWARD BILLMAN, A. M.....	President
WM. STOWE DEVOL, B. Agr., Director.....	Agriculturist and Horticulturist
EDWARD M. BOGGS	Irrigation Engineer and Meteorologist
JAMES W. TOUMEY, B. S.....	Botanist and Entomologist
ROBERT H. FORBES, B. S.....	hemist

MARK WALKER, JR.....	Assistant in Chemical Laboratory	} Station No. 1, Tucson
HARRY G. WOLFGANG.....	Florist and Assistant Horticulturist	
G. M. GILLET	Assistant Meteorologist	
LEE LACHANCE.....	Stenographer	
FELIX G. HAVENS	Foreman	
N. H. CLAFLIN, M. D.....	Foreman Station No. 2, Phoenix	

*The Bulletins of the Station are sent to all residents of
Arizona applying for them.*

The Experiment Station respectfully solicits suggestions relating to the important work it is attempting to accomplish in the development of the agricultural resources of the Territory.

Questions upon subjects within the scope of the Station work will be cheerfully answered whenever possible.

Address all communications to

DIRECTOR EXPERIMENT STATION,
Tucson, Arizona.

EIGHTH ANNUAL REPORT.

3

FINANCIAL REPORT

*For the Fiscal Year Ending June 30th, 1897. Agricultural Experiment
Station of the University of Arizona, in account with*

THE UNITED STATES APPROPRIATION, 1896-7.

DR.		
To receipts from the Treasurer of the United States as per ap- propriation for fiscal year ending June 30, 1897, as per Act of Congress approved March 2, 1887.....		\$ 15000.00
CR.		
Abstract		
By Salaries.....	1.	\$ 6734 14
Labor.....	2.	4687 43
Publications.....	3.	530 98
Postage and stationery.....	4.	153 15
Freight and express.....	5.	100 66
Heat, light and water.....	6.	49 56
Chemical supplies.....	7.	204 32
Seeds, plants and sundry supplies.....	8.	189 91
Fertilizers.....	9.	369 75
Feeding stuffs.....	10.	242 91
Library.....	11.	17 34
Tools, implements and machinery.....	12.	182 39
Furniture and fixtures.....	13.	41 74
Scientific apparatus.....	14.	247 18
Live stock.....	15.	
Traveling expenses.....	16.	447 95
Contingent expenses.....	17.	375 85
Building and repairs.....	18.	424 09
Balance.....		65
Totals.....		\$ 15000 00

We, the undersigned, duly appointed auditors for the corporation, do hereby certify that we have examined the books and accounts of the Experiment Station of the University of Arizona, for the fiscal year ending June 30th, 1897; that we have found the same well kept and correctly classified as above, and that the receipts for the time named are shown to have been \$15,000 00, and the corresponding disbursements \$14999 35, for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving \$0.65

HOWARD BILLMAN,
SELIM M. FRANKLIN,
Auditing Committee of the Board of Regents.

I hereby certify that the foregoing statement of account, to which this is attached, is a true statement from the books of account of the institution named.

[SEAL]

SELIM M. FRANKLIN,
Treasurer.

We, the undersigned, do hereby certify that the above is the signature of Selim M. Franklin, treasurer of the Agricultural Experiment Station of the University of Arizona, and that the above is the seal of said institution.

JOHN H. MARTIN,
Secretary Agricultural Experiment Station,
University of Arizona.

WM. STOWE DEVOL,
Director of the Experiment Station

List of Bulletins

PUBLISHED BY THE ARIZONA AGRICULTURAL EXPERIMENT
STATION TO JUNE 30TH, 1897.

- 1—Arizona Experiment Station, 4 pages.
- * 2—Part I, Notes on Some of the Range Grasses of Arizona }
Part II, Overstocking the Range. } 11 pages.
- * 3—Irrigation in Arizona, 14 pages.
- * 4—Waters and Water Analysis, 16 pages.
- 5—Canaigre, 5 pages.
- 6—Soils and Waters, 8 pages.
- 7—Canaigre, 40 pages.
- * 8—Cattle Feeding, 10 pages.
- * 9—Insects and Insecticides, 10 pages.
- 10—Experimental Work at Willcox, 16 pages.
- 11—Agricultural Development in Southwestern Arizona, 8 pages.
- 12—Preliminary Report of Observations on the Crown-Knot, 11 pages.
- 13—The Mesquite Tree: Its Products and Uses, 13 pages.
- *14—Notes on Scale Insects in Arizona, 28 pages.
- 15—List of Varieties of Fruits, 19 pages.
- *16—Notes on Apricots at Phoenix Station, 15 pages.
- 17—Agricultural Convention. Part I, 30 pages.
- 18—Agricultural Convention. Part II, 24 pages.
- 19—Sixth Annual Report, 8 pages.
- *20—Arizona Weather, 38 pages.
- 21—Canaigre, 35 pages.
- 22—Something About Weeds, 32 pages.
- *23—Sugar Beets, 44 pages.
- 24—Seventh Annual Report, 10 pages.
- 25—Eighth Annual Report, 9 pages.

The supply of bulletin marked thus (*) is exhausted. Copies of all others will be sent free to applicants so long as the supply lasts. Address

DIRECTOR EXPERIMENT STATION,
Tucson, Arizona.

REPORT OF THE DIRECTOR.

HOWARD BILLMAN, *President University of Arizona.*

DEAR SIR:—I have the honor to submit herewith the Eighth Annual Report of the Arizona Agricultural Experiment Station. In compliance with the request of the Director of the Office of Experiment Stations, United States Department of Agriculture, Washington, D. C., the date of issuing the annual report is changed from December 31st to June 30th in order that the operations reported upon may correspond with the financial statement for the fiscal year. This report, therefore, covers operations for six months only from January 1st to June 30th, 1897.

The Experiment Station has done more work, both of practical and scientific nature, during the past six months than for any similar period in its history, and I am pleased to note that the character of work is steadily improving in quality. The energies of the Director have been given more to furthering experiments with sugar beets than in any other direction. I have visited all the valleys under irrigation containing a sufficient area of land for the culture of the sugar beet to warrant the trial of this crop in the several localities, and sugar beet seed was distributed to those farmers who would agree to undertake growing beets therefrom and keep a record of all operations performed in the experiment. These and others throughout the Territory receiving seeds make a total of about 300 individuals. Since the seed was planted the Director has again visited all the larger valleys for the purpose of inspecting the growing crop and give such instructions as might be found necessary to secure the best results from the experiments. For the purpose of undertaking this work in as thorough a manner as possible the station purchased 175 pounds of sugar beet seed and in addition thereto received a donation from the Chino Valley Beet Sugar Factory, of Chino, California, of 150 pounds of seed, and from the United States Department of Agriculture 200 pounds of seed. Although a number of failures are already recorded among those who are tryin sugar beets, there is a sufficient number having good success in the experiment to warrant the belief that the results will be most satisfactory. For the purpose of making a still more careful examination of the sugar beet in this Territory about two and one half acres of ground was planted to beets at the Phoenix Station and nearly as much upon the grounds leased for the use of the Station at Tucson. Additional ground has also been obtained for the sugar beet and tobacco work. In addition to the sugar beet seed quite a quantity of seeds of tobacco, of Australian salt bush and of ramie have been distributed throughout the Territory.

The experiments with canaigre have been prosecuted with vigor at both the Phoenix and Tucson Stations and the crop is now being harvested, with indications that it will be larger than was anticipated.

The experiments with grasses and forage plants suited to arid regions have been continued upon the Phoenix Station. In addition to

those planted last year there have been sown about one hundred other varieties of seeds of grass and forage plants, as follows, each being sown in four different ways:

Atriplex canescens (white sage), *A. Australia* (old man salt bush), *A. Halmoides*, *A. Letocarpa*, *A. Numularia* (New Zealand salt bush), *A. Truncata* (Utah salt bush), *Poa Arachnifera* (Texas bluegrass), *P. Pratensis* (Kentucky blue grass), *P. Nemoralis* (Northern blue grass), *P. Fertilis*, *P. Compressa*, *P. Buckleyana*, *P. Trivialis* (roughish meadow grass), *Phalaris Carolinica* (Carolina timothy), *Agropyrum divergens* (bunch grass of Oregon), *A. Acutum Europe*, *A. Richardsoni* (bunch wheat grass), *A. pseudorepens*, *A. Repens* (quack grass), *A. Spicatum* western (wheat grass), *A. Tenerum* (sleander wheat grass), *Bromus inermis* (Hungarian brome grass), *B. Advensis*, *B. Carinatus*, *B. Ciliatus*, *B. Giganteus*, *B. Mollis*, *B. Pratensis*, *B. Purgans*, *B. Tectorum* L., *Phleum pratense* (timothy), *Melilotus alba* (Bokhara clover), *Medicago sativa* (alfalfa), *M. Lupulina*, *M. Media*, *Trifolium hybridum* (Alsike clover), *T. Incarnatum* (crimson clover), *T. Pratense* (red clover), *T. Repens* (white clover), *T. Longipes* (Rocky Mountain clover), *T. Beckwithii*, *Lathyrus sylvestris* (flat pea), *Anthyllis vulneraria* (horn pod clover), *Vicia villosa* (hairy vetch), *Gozsia pungens* (Korean lawn grass), *Lolium perenne* (English rye), *L. perenne tenue*, *L. Italicum*, *Sporobolus Wrightii* (Saccatone), Kooma seed from mountains of Persia, *Avena elatior* (tall oat grass), *Festuca Augustifolia*, *F. arundinacea*, *F. Fenas*, *F. heterophylla*, *F. fluitans*, *F. ovina Arizona*, *F. Ovina* Var, *F. ovina durinacula*, *F. ovina* Var (Montana sheeps fescue), *F. ovina*, *F. ovina sulcata*, *F. pratensis*, *F. Rubra glaucescens* (Tennessee fescue), *Agropogon cannum* (Bearded wheat grass), *Panicularia aquaticus*, *Panicum colonum*, *P. Crusgalli*, *P. frumentesceum*, *P. Virgatum* (switch grass), *Paspalum pubiflorum glabrum*, *Phalaris arundinacea* (reed canary grass), *Hilaria cenchroides*, *H. Jamesii*, *H. Rigida*, *Hordeum adscendens*, *H. bulbosum*, *H. Chilense*, *H. pratense*, *Becmania erucaeformis* (water timothy), *Boutiloua micrastachya* (six weeks gamma), *Bigelovia graveolens albucaulis*, *Aira flexuosa*, *A. cespitosa*, *Agrostis stolonifera* (broad leaved creeping bent grass), *A. capilaris*, *Paspalum dilitatum* (hairy flowered paspalum), *Stipa robustia*, *Soja hispida* (Soja bean), *Astragalus crassicaupus* (Buf-falo pea), *Housakia purshiana*.

Experiments with Australian salt bush have been continued and the results are confirmatory of the opinion expressed some time since, to the effect that it may prove a valuable forage plant for this region. A larger area has been set to tobacco than was planted last year, although a smaller number of varieties are growing this year. The experiments with ramie this season show that the plant still continues making satisfactory growth and it will apparently prove a valuable crop for this region should satisfactory decorticating machinery be devised.

Early frosts have been very disastrous with some varieties of fruit more so this season than usual. The almond crop is entirely destroyed

and most of the peaches as well. The apricot crop though small is very good.

But a part of the time of the florist has been given to greenhouse work though a very large number of tobacco plants have been propagated and experiments have been conducted in the growing of Australian salt bush plants, and in the production of tomatoes under glass. This latter experiment has been very interesting indeed and a large crop of tomatoes has been grown; the quality has been superior. Care has been given to the preparation of the soil of the proper character for these experiments resulting in a mixture which is found to be very friable, easily worked and yet sufficiently compact to hold moisture well and sufficiently rich to give a vigorous and healthy growth.

During the past six months the following bulletins have been issued:

No. 22 "Something about Weeds" by James W. Toumey, Botanist and Entomologist, 32 pages;

No. 23 "Sugar Beets" by Wm. Stowe Devol, *Director*, Agriculturist and Horticulturist, assisted by the other members of the station staff, 44 pages:

No. 24 Seventh Annual Report, by the Director, 10 pages;

No. 25 Eighth Annual Report, by the Director and other members of the Station staff, 9 pages.

The Director has also prepared and distributed press bulletins Nos. 10, 11, 12, 13. These press bulletins have been published very generally by the news papers of the Territory who have also been very liberal in publishing other matters respecting the Experiment Station and its work.

There have been some changes in the working force of the Experiment Station. Mr. Felix G. Havens has been secured as foreman of the Station and University grounds at Tucson. Mr. H. G. Wolfgang has been made Florist and Assistant Horticulturist. Mr. E. M. Boggs has been granted a leave of absence for the ensuing year.

There have been some additions to the equipment of the agricultural and horticultural departments. None, however, have entailed the expenditure of a very large sum of money. The following are the most important items:

September, 1896, 1 breaking plow.....	\$14.75.
October, " 1 small plow.....	7.00.
May, 1897, 1 canaigre digger.....	7.30.
" 1 California cultivator.....	18.00.

In addition thereto hand tools have been purchased to the amount of \$24.00. We have also received from D. M. Osborne, San Francisco, California, one Flexible Reversible disk harrow in exchange for the wooden frame harrow which we were using. This is a very valuable implement as we find it well suited for throwing soil to or from fruit trees, also a convenient implement for cleaning out shallow irrigation ditches as well as for stirring the soil, for which purpose it was designed.



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Following may be found the reports of the other members of the station staff as transmitted to me.

Very respectfully submitted,

Your obedient servant,

WM. STOWE DEVOL,

Director.

TUCSON, ARIZONA, June 2, 1897.

PROFESSOR W. S. DEVOL, *Director.*

DEAR SIR:—The financial statement of this department for the past eighteen months is as follows:

Jan. 23, 1896, Paper for herbarium use	\$14.10.
“ Sterilizer.....	30.00.
June 26, 1896, Microscopical apparatus.....	109.55.
“ Bacteriological.....	99.87.

Two bulletins have been issued:

No. 14, Notes on Scale insects in Arizona.

No. 22, Somthing about Weeds.

Estimated material needed until October, 1897 is now in the hands of President Billman.

The work of the department for the past eighteen months has been covered by monthly reports

Respectfully submitted,

J. W. TOUMEY,

Botanist and Entomologist.

TUCSON, ARIZONA, June 1st, 1897.

DIRECTOR W. S. DEVOL, *Experiment Station, Tucson, Arizona.*

DEAR SIR:—Concerning the work of the chemical department of the Arizona Experiment Station for the past six months I have to report that the time of the assistant has been occupied chiefly in the analysis of a collection of representative soils from the Salt River Valley. This work which has been under way for the better part of a year is now nearing completion and through it a fair idea of the character of the soils of this important agricultural region has been obtained. It is thought that the data obtained will have important suggestions for the fertilization of the orchards and other crops which are being attempted in this region. It is hoped that a bulletin embodying the results obtained may be gotten ready early in the fall.

The time of the chemist has been largely occupied by additional investigations of canaigre. A complete proximate analysis of this material has been successfully carried through and a number of additional substances determined and discovered; the relation of composition to the commercial properties of the plant, such as color, sugar, tanning materials and others, determined; and through the knowledge obtained an improved method of analysis has been perfected. The material embodied in Bulletin 21 has been rewritten and additions made to it along the